

WHAT IS CLAIMED IS:

1. A distributed digital signature generation method for generating a digital signature  
5 for a digital document by using a plurality of partial digital signature generation parts, said distributed digital signature generation method comprising the steps of:
- 10 each of said partial digital signature generation parts generating a partial signature key by communicating with each other without using a trusted third party;
  - each of said partial digital signature generation parts generating a partial digital  
15 signature by using said partial signature key for a hash value of an input digital document;
  - each of said partial digital signature generation parts outputting said partial digital signature or a pair of said digital document and  
20 said partial digital signature;
  - combining a predetermined number of partial digital signatures generated by said partial digital signature parts wherein said predetermined number is a threshold;
  - 25 performing a transformation process on each of said predetermined number of partial digital signatures according to combination of said predetermined number of partial digital signatures; and
  - 30 generating an integrated digital signature from a result of said transformation process.
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2. The distributed digital signature generation method as claimed in claim 1, wherein a

least common multiple of predetermined values is used as a transformation number in said transformation process.

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3. The distributed digital signature generation method as claimed in claim 1, said method  
10 further comprising the step of:

judging whether an incorrect partial digital signature generated by an incorrect partial signature key exists, and identifying said incorrect partial digital signature by combining said  
15 predetermined number of said partial digital signatures and performing a signature verification process.

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4. A distributed digital signature generation method for generating a digital signature for a digital document by using a plurality of  
25 partial digital signature generation parts, said method comprising the steps of:

each of said partial digital signature generation parts adding one or more items of additional information to an input digital document  
30 to generate a digital document with additional information;

each of said partial digital signature generation parts generating a partial signature key by communicating with each other without using a  
35 trusted third party;

each of said partial digital signature generation parts generating a partial digital

signature by using said partial signature key for a hash value of said digital document with additional information;

each of said partial digital signature  
5 generation parts outputting a pair of said digital document with additional information and said partial digital signature;

combining a predetermined number of said pairs of said digital document with additional  
10 information and said partial digital signature wherein said predetermined number is a threshold;

performing a transformation process on  
each of said predetermined number of partial digital signatures according to combination of said  
15 predetermined number of pairs; and

generating an integrated digital signature from a result of said transformation process.

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5. The distributed digital signature generation method as claimed in claim 5, wherein a least common multiple of predetermined values is  
25 used as a transformation number in said transformation process.

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6. The distributed digital signature generation method as claimed in claim 4, said method further comprising the step of:

judging whether an incorrect partial  
35 digital signature generated by an incorrect partial signature key exist and identifying said incorrect partial digital signature by combining said

predetermined number of said partial digital signatures and performing a signature verification process.

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7. A distributed digital signature generation apparatus for generating a digital signature for a digital document by using a plurality of partial digital signature generation parts, wherein:

each of said partial digital signature generation parts generates a partial signature key by communicating with each other without using a trusted third party;

each of said partial digital signature generation parts generates a partial digital signature by using said partial signature key for a hash value of an input digital document;

each of said partial digital signature generation parts outputs said partial digital signature or a pair of said digital document and said partial digital signature;

said distributed digital signature generation apparatus comprising:

a part for combining a predetermined number of partial digital signatures generated by said partial digital signature parts wherein said predetermined number is a threshold;

a part for performing a transformation process on each of said predetermined number of partial digital signatures according to combination of said predetermined number of partial digital signatures; and

a part for generating an integrated digital signature from a result of said

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information;

each of said partial digital signature generation parts generates a partial signature key by communicating with each other without using a  
5 trusted third party;

each of said partial digital signature generation parts generates a partial digital signature by using said partial signature key for a hash value of said digital document with additional  
10 information;

each of said partial digital signature generation parts outputs a pair of said digital document with additional information and said partial digital signature;

15 said distributed digital signature generation apparatus comprising:

a part for combining a predetermined number of said pairs of said digital document with additional information and said partial digital  
20 signature wherein said predetermined number is a threshold;

a part for performing a transformation process on each of said predetermined number of partial digital signatures according to combination  
25 of said predetermined number of pairs; and

a part for generating an integrated digital signature from a result of said transformation process.

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11. The distributed digital signature generation apparatus as claimed in claim 10, wherein  
35 a least common multiple of predetermined values is used as a transformation number in said transformation process.

5                   12. The distributed digital signature  
generation apparatus as claimed in claim 10, said  
apparatus further comprising:

                  a part for judging whether an incorrect  
partial digital signature generated by an incorrect  
10 partial signature key exists and specifying said  
incorrect partial digital signature by combining  
said predetermined number of said partial digital  
signatures and performing a signature verification  
process.

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                  13. A digitally signed digital document  
20 generation method for generating a digital document  
with a digital signature generated by using a  
plurality of partial digital signature generation  
parts, said digitally signed digital document  
generation method comprising the steps of:

25                   each of said partial digital signature  
generation parts generating a partial signature key  
by communicating with each other without using a  
trusted third party;

                  each of said partial digital signature  
30 generation parts generating a partial digital  
signature by using said partial signature key for a  
hash value of an input digital document;

                  each of said partial digital signature  
generation parts outputting said partial digital  
35 signature or a pair of said digital document and  
said partial digital signature;

                  combining a predetermined number of

performing a transformation process on  
5 each of said predetermined number of partial digital  
signatures according to combination of said  
predetermined number of partial digital signatures;  
generating an integrated digital signature  
from a result of said transformation process; and  
0 generating a digital document with digital  
signature which includes said digital document and  
said integrated digital signature.

14. A digitally signed digital document generation method for generating a digital document with a digital signature generated by using a plurality of partial digital signature generation parts, said digitally signed digital document generation method comprising the steps of:

each of said partial digital signature  
generation parts generating a partial signature key  
30 by communicating with each other without using a  
trusted third party;

each of said partial digital signature



generation parts outputting a pair of said digital document with additional information and said partial digital signature;

- combining a predetermined number of said
- 5 pairs of said digital document with additional information and said partial digital signature wherein said predetermined number is a threshold;
- performing a transformation process on each of said predetermined number of partial digital
- 10 signatures according to combination of said predetermined number of pairs; and
- generating an integrated digital signature from a result of said transformation process; and
- generating a digital document with digital
- 15 signature which includes said digital document and said integrated digital signature.

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15. A digitally signed digital document generation apparatus for generating a digital document with a digital signature generated by using a plurality of partial digital signature generation

25 parts, wherein:

- each of said partial digital signature generation parts generates a partial signature key by communicating with each other without using a trusted third party;
- 30 each of said partial digital signature generation parts generates a partial digital signature by using said partial signature key for a hash value of an input digital document;
- each of said partial digital signature
- 35 generation parts outputs said partial digital signature or a pair of said digital document and said partial digital signature;

said digitally signed digital document generation apparatus comprising:

5 a part for combining a predetermined number of partial digital signatures generated by said partial digital signature parts wherein said predetermined number is a threshold;

10 a part for performing a transformation process on each of said predetermined number of partial digital signatures according to combination of said predetermined number of partial digital signatures;

a part for generating an integrated digital signature from a result of said transformation process; and

15 a part for generating a digital document with digital signature which includes said digital document and said integrated digital signature.

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16. A digitally signed digital document generation apparatus for generating a digital document with a digital signature generated by using  
25 a plurality of partial digital signature generation parts, wherein:

each of said partial digital signature generation parts adds one or more items of additional information to an input digital document  
30 to generate a digital document with additional information;

each of said partial digital signature generation parts generates a partial signature key by communicating with each other without using a  
35 trusted third party;

each of said partial digital signature generation parts generates a partial digital

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signature by using said partial signature key for a hash value of said digital document with additional information;

- each of said partial digital signature
- 5 generation parts outputs a pair of said digital document with additional information and said partial digital signature;
- said digitally signed digital document generation apparatus comprising:
- 10 a part for combining a predetermined number of said pairs of said digital document with additional information and said partial digital signature wherein said predetermined number is a threshold;
- 15 a part for performing a transformation process on each of said predetermined number of partial digital signatures according to combination of said predetermined number of pairs;
- a part for generating an integrated
- 20 digital signature from a result of said transformation process; and
- a part for generating a digital document with digital signature which includes said digital document and said integrated digital signature.
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17. A program for causing a computer to generate a digital signature for a digital document by using a plurality of partial digital signature generation parts, wherein:

- 35 each of said partial digital signature generation parts generates a partial signature key by communicating with each other without using a

trusted third party;

each of said partial digital signature generation parts generates a partial digital signature by using said partial signature key for a  
5 hash value of an input digital document;

each of said partial digital signature generation parts outputs said partial digital signature or a pair of said digital document and said partial digital signature;

10 said program comprising:

program code means for combining a predetermined number of partial digital signatures generated by said partial digital signature parts wherein said predetermined number is a threshold;

15 program code means for performing a transformation process on each of said predetermined number of partial digital signatures according to combination of said predetermined number of partial digital signatures; and

20 program code means for generating an integrated digital signature from a result of said transformation process.

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18. A program for causing a computer to generate a digital signature for a digital document by using a plurality of partial digital signature generation parts, wherein:

30 each of said partial digital signature generation parts adds one or more items of additional information to an input digital document to generate a digital document with additional  
35 information;

each of said partial digital signature generation parts generates a partial signature key

by communicating with each other without using a trusted third party;

each of said partial digital signature generation parts generates a partial digital signature by using said partial signature key for a hash value of said digital document with additional information;

each of said partial digital signature generation parts outputs a pair of said digital document with additional information and said partial digital signature;

said program comprising:

program code means for combining a predetermined number of said pairs of said digital document with additional information and said partial digital signature wherein said predetermined number is a threshold;

program code means for performing a transformation process on each of said predetermined number of partial digital signatures according to combination of said predetermined number of pairs; and

program code means for generating an integrated digital signature from a result of said transformation process.

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19. A computer readable medium storing program code for causing a computer to generate a digital signature for a digital document by using a plurality of partial digital signature generation parts, wherein:

each of said partial digital signature generation parts generates a partial signature key

by communicating with each other without using a trusted third party;

each of said partial digital signature generation parts generates a partial digital signature by using said partial signature key for a hash value of an input digital document;

each of said partial digital signature generation parts outputs said partial digital signature or a pair of said digital document and said partial digital signature;

said computer readable medium comprising:  
program code means for combining a predetermined number of partial digital signatures generated by said partial digital signature parts wherein said predetermined number is a threshold;  
program code means for performing a transformation process on each of said predetermined number of partial digital signatures according to combination of said predetermined number of partial digital signatures; and  
program code means for generating an integrated digital signature from a result of said transformation process.

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20. A computer readable medium storing program code for causing a computer to generate a digital signature for a digital document by using a plurality of partial digital signature generation parts, wherein:

each of said partial digital signature generation parts adds one or more items of additional information to an input digital document to generate a digital document with additional information;

5           each of said partial digital signature  
generation parts generates a partial digital  
signature by using said partial signature key for a  
hash value of said digital document with additional  
information;

15           said computer readable medium comprising:  
          program code means for combining a  
          predetermined number of said pairs of said digital  
          document with additional information and said  
          partial digital signature wherein said predetermined  
          number is a threshold;

25           program code means for generating an  
integrated digital signature from a result of said  
transformation process.

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